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INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION
BETWEEN CANADA AND THE UNITED STATES FOR THE
PROTECTION, PRESERVATION AND EXTENSION OF
THE SOCKEYE SALMON FISHERIES IN
THE FRASER RIVER SYSTEM

ANNUAL REPORT
1954

COMMISSIONERS

SENATOR THOMAS REID	A. J. WHITMORE
ELTON B. JONES	ROBERT J. SCHOETTLER
H. R. MacMILLAN	ARNIE J. SUOMELA

NEW WESTMINSTER
CANADA
1955

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS

AND PERIOD OF SERVICE

SINCE THE INCEPTION OF THE COMMISSION

IN 1937

CANADA		UNITED STATES	
William A. Found	1937-1939	Edward W. Allen	1937-1951
A. L. Hagèr	1937-1948	B. M. Brennan	1937-1942
Senator Thomas Reid	1937-	Charles E. Jackson	1937-1946
A. J. Whitmore	1939-	Fred J. Foster	1943-1947
Olof Hanson	1948-1952	Milo Moore	1946-1949
H. R. MacMillan, C.B.E., D.Sc.	1952-	Albert M. Day	1947-1954
		Alvin Anderson	1949-1950
		Robert J. Schoettler	1951-
		Elton B. Jones	1951-
		Arnie J. Suomela	1954-

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ALBERT M. DAY
(January to May)
ARNIE J. SUOMELA
(May to December)

OFFICERS

LOYD A. ROYAL
Director

ROY I. JACKSON
Assistant Director

NEW WESTMINSTER
CANADA
1955

THE PEACE ARCH—A monument to the spirit of international good will existing between Canada and the United States. The Peace Arch is located at the intersection of the international boundary with the waters of Puget Sound and the Gulf of Georgia. The boats in the background belong to United States fishermen who are heading for their sockeye fishing grounds, adjacent to those of Canada, near the mouth of the Fraser.

REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1954

The remarkable increase in the annual Fraser River sockeye catch for each of the last four years over that obtained in the parent year of each of the four cycles has completely justified the Sockeye Fisheries Convention ratified on July 28, 1937 by Canada and the United States. It is evident, from examination of the magnitude and consistency of the increases in catch that the purpose of the Convention to protect, preserve and extend the sockeye salmon fishery of the Fraser River system is being fulfilled. The sockeye catch for 1954 was 9,529,000 fish as compared with a catch of 2,115,000 fish for the brood year of 1950. The catch in 1953 was 4,025,000 fish compared with 2,078,000 fish in 1949. In 1952, 2,268,000 sockeye were taken compared with 1,842,000 sockeye caught in the brood year of 1948. The catch of 2,425,000 sockeye in 1951 was a spectacular increase over the 443,000 sockeye taken in 1947.

Thus the total catch for the four-year period from 1951 to 1954 was 18,246,000 sockeye compared with 6,478,000 sockeye taken in the previous brood years of 1947-1950. The current wholesale value of the *increase* in the pack for the last four years is $42,192,000.

Regulations designed to meet the terms of the Convention that the allowable catch be divided equally, as nearly as may be practical, between the fishermen of Canada and the United States have in effect permitted Canadian fishermen to take 9,157,000 sockeye during the last four years whereas the United States fishermen took 9,089,000 sockeye. The difference of only 68,000 fish in favor of Canadian fishermen represents practical equality in the catch or 50.2 per cent for Canada and 49.8 per cent for the United States (Table II).

The current sockeye pack is still far below that obtained prior to the Hell's Gate disaster; the pack for the last four years represents about 56 per cent of the sockeye packed during the four-year period, 1910-1913, immediately preceding the Hell's Gate slide. Certain populations are increasing at a rapid rate, while others appear to be unstable and others again are extinct. Problems of managing individual populations to permit their maximum productivity or complete rehabilitation are not yet entirely solved. *A great amount of research and experimentation may be required to return the Fraser River to full productivity.* Methods of replacing extinct populations are just starting to meet with success and the future stability of newly established runs must be determined. Additional knowledge concerning the complex effect of the Hell's Gate block on the various runs is being obtained each year, yet full knowledge of these effects may not be available for many years. However, it appears that once this knowledge is complete, salmon management may be achieved by adherence to simple but obligatory functioning formulas.

The fishing industry finds it important to its economy to have the best available knowledge of the potential annual and cyclical catch of future years. Originally, all of the spawning and rearing areas above Hell's Gate produced one great run every fourth year and all of the areas produced that run on the same cycle year (1913). An important question is whether the catch from each of the four-yearly cycles may be expected to increase substantially or whether the catch from certain of the four cycles will stabilize at a low level as it did in the early years of the Fraser River fishery. This question is currently difficult to answer but it seems that the Hell's Gate obstruction may have permanently affected the cycle in which certain races obtain their maximum production. Our current research shows that in the future, the production of one year's run will not be greater than the runs of the other three years combined, as it was originally. Hell's Gate affected each population to a varying degree depending upon several factors, the principal one being the time of arrival of the fish at the obstruction. Since the construction of the fishways, and in a few instances even before the construction of the fishways, populations have started to recover from the effects of the block and some have now established their dominant quadrennial cycle of production on a different cycle from the original one. This change of cyclical productivity can only result in relatively greater production in the original off-years and less production in the big year belonging to the once-great 1909-1913 cycle. To determine how production may fluctuate from year to year in the future, the original size of each population must be estimated. In addition, the degree of current rehabilitation and the future rate of increase of each race, as well as the possibility of reviving extinct races, must be assessed. To obtain even an approximation of the future cyclical trends of Fraser River sockeye the past and present history of each race or population must be studied. The available information in many cases is too incomplete for accurate assessment but it is presented briefly as follows:

Stuart River District

Recent studies of the sockeye catch statistics for the years 1897 to 1913 inclusive, preceding the Hell's Gate obstruction, indicate that the importance of the Stuart River district as a sockeye producer has in the past never been officially recognized. There are indications that it once produced sockeye in numbers exceeded only by the Quesnel and South Thompson River districts. Excellent Indian catch records have been provided by the Hudson's Bay Company with references dating back to 1811 for the Fort St. James fishery at the outlet of Stuart Lake. Evidence is available from these records that a very large run occurred on the 1913 cycle at least as far back as 1825 and that in two years out of every four the run was almost a complete failure. The dominant quadrennial cycle of great production was thus in evidence over a century ago.

The effects of the Hell's Gate obstruction on the Stuart River run may not be accurately measured for many years to come. However, the ability of the area to recover in part from the effects of the obstruction has been spectacular and indicates its great potential as a sockeye producer. In 1941, one cycle before the operation of the Hell's Gate fishways, the escapement of the "early run" was

6306 and the escapement of the "late run" was 5500, totalling 11,806 spawning sockeye for the entire district. In 1953, two cycles after the construction of the fishways the escapement totalled 154,000 for the early run and 355,000 for the late run. The 1953 catch and escapement of both early and late runs combined is estimated at over 2,500,000 fish. The important runs to this area are thus being rehabilitated on the 1913-1957 cycle and may be expected to re-occur every fourth year in the future. On the basis of existing historical records it is assumed that the runs in the intervening three years will not be of great importance.

The Early Stuart run of approximately 1,000,000 sockeye in 1953 is estimated to have been the greatest in the history of the river. No records are available to indicate its existence prior to about 1890. Its appearance after that time is yet to be explained but its importance in the future seems to be permanent unless its productivity is affected by the reviving Late Stuart run. If the latter does not occur it is possible that the record Early Stuart run of 1953 may even be exceeded in future years of the cycle.

Historical data show that the present Late Stuart run is migrating almost two weeks earlier than it did in the years prior to the Hell's Gate block. As a result of this early migration the arriving spawners are being subjected to high water temperatures on the spawning grounds which appear to cause excessive mortality of unspawned fish. In 1953 approximately 50 per cent of the run died unspawned thus lowering the potential increase in the 1957 population by perhaps as much as 2,000,000 sockeye. A later migration is essential if the spawners are to produce a maximum population. Complete restoration of the original Late Stuart population of sockeye appears to depend on the establishment of a later migration through regulations designed to allow a higher percentage of the late migrants of the existing run to escape to the spawning grounds. The future dominant run of Late Stuart sockeye is expected to increase in size in spite of being improperly timed with respect to much of the reproductive environment and to occur every four years on its original cycle (1913-1957). Production of the other three cycles is expected to be relatively low.

Fraser-Francois Lake District

Indian catches recorded at Fort Fraser indicate little, if any, change in the current timing of sockeye runs to this district from that of early years. The run is essentially divided into two parts; of these the early run is destined for the tributaries of Francois Lake, principally the Nadina River, whereas the late run spawns principally in the Stellako River that drains Francois Lake into Fraser Lake. The early run appears originally to have been almost as large as the Stellako or late run but was more seriously affected by the Hell's Gate obstruction. The historical reports are vague however, and only time will show what size this run is capable of reaching. Already it is rehabilitating rapidly on the original cycle (1913-1957) and is increasing to some extent in the off years.

The Stellako or late run was not as seriously affected by Hell's Gate and already in 1954 appears to have approached its potential maximum size. Thus the

dominant cycle now occurs a year later than the original cycle of greatest importance. Important evidence found in the Indian catch records provided by the Hudson's Bay Company for this area indicates that only one of the four cycles ever "failed". Failure was cyclical and occurred in the year preceding the largest run. Both the other two cycles had runs of fair size but not as large as the run of the dominant year. It appears that any substantial increase in production from the Fraser-Francois district must originate from the early run spawning in the Nadina River and it is currently expected that such an increase will occur principally on the original cycle (1913-1957).

Bowron River District

Little is known about the sockeye production of the Bowron River in earlier years. No evidence is available to determine whether a large run occurred every fourth year or what the sizes of the runs were. It is believed, however, that the sockeye production of this system is rigidly controlled by the small size of the rearing area (Bowron Lake) and that the rehabilitation of the runs is almost completed. Recent annual runs have varied in size around a total of 100,000 sockeye.

Quesnel River District

Escapement records obtained at a dam located at the outlet of Quesnel Lake prior to the Hell's Gate slide indicate that the Quesnel run may have been the largest of any run of sockeye in the Fraser system. Evidence is available to indicate that the total cyclic population in 1909 and in 1913 may have exceeded 10,000,000 sockeye. This historically famous run of salmon spawned principally in the Horsefly and Mitchell Rivers. The Hell's Gate obstruction so reduced the original large run that by 1941 only an estimated 1000 spawners remained. With the construction of the Hell's Gate fishways in 1945 and the advent of special regulations in 1949 the spawning escapement was increased to 107,500 fish in 1953. It seems certain that rehabilitation will occur on the original dominant cycle (1913-1957) and historical records suggest that the runs in the intervening years will be relatively unimportant, the only other cycle run of significant economic importance occurring eventually on the year following the dominant year.

Like the Late Stuart run the current Quesnel population represents only the early-migrating part of the original run and maximum rehabilitation depends on whether the rapidly increasing population will adjust the timing of its migration in part to meet the environmental requirements of the now-barren spawning areas. The current spawners utilize only the upper part of the Upper Horsefly River while the central and lower portions of the same river are barren. The two lower areas have a later seasonal timing in the environmental cycle than that which occurs in the upper area. Regulation of the fishery appears to be a required adjunct to this adjustment and it must be carefully designed to permit a heavy escapement of the later-migrating fish. In spite of the early migration of the 1953 Quesnel run considerable increase is expected in the population returning in future years of this cycle.

Chilko Lake District

Like all other important sockeye-producing districts Chilko Lake had a dominant year of productivity on the original 1913 cycle. Historical records show that the production pattern varied from that of other districts in that the year of next greatest production preceded rather than followed the dominant year. In two years out of every four the run was relatively unimportant.

The run to Chilko Lake survived the effects of the Hell's Gate obstruction to a greater degree than many other runs probably because the fish were physiologically better able to surmount the turbulent area created at the Gate. The Chilko sockeye spawn at an elevation of 3800 feet above sea level whereas most of the other runs spawn at an elevation of less than 2400 feet above sea level. It is believed that the 1940 and 1941 runs approached the maximum populations which this area is capable of producing but unfortunately the escapement of the large and dominant run in 1941 was seriously blocked and delayed at Hell's Gate. This block in 1941 resulted in a shift of the dominant cycle to one year earlier than the originally dominant 1913 cycle (1912-1956). The sub-dominant year of productivity has also shifted and the Chilko Lake area is now in the process of establishing a new annual pattern of cyclic productivity. Maximum annual production, possible in the dominant cycle only, appears to be approximately 3,000,000 fish.

Taseko Lake, located in the same watershed, was officially unknown as a sockeye producer until recent years when as many as several thousand fish were observed spawning on the lake shore. The lake is highly discolored from inflowing glacial silt and lies at an elevation of 4400 feet above sea level. It is doubtful if the run to this area will ever reach a size of any great importance and, as at Chilko, it may be approaching its maximum. Since historical records of the Taseko run are non-existent only future runs will determine the actual potential of this area as a sockeye producer.

Seton-Anderson Lake District

Two native sockeye populations are known to have existed prior to 1913 in the Seton-Anderson Lake watershed. The larger and more important run spawned in Gates Creek, a tributary of Anderson Lake. The escapement to Gates Creek in 1905 was estimated by Provincial Fisheries officials to be between 150,000 and 200,000 sockeye. Unfortunately that year's spawning population was practically destroyed by hatchery operations and recovery was prevented until recent years by the Hell's Gate obstruction. The run, which passes through the fishery in late July and early August, is now starting to increase on a new cycle, namely the 1912-1956 cycle, and in 1952 had an escapement of 6883 sockeye. It may be possible that on this cycle the Gates Creek population may reach a size of over 500,000 sockeye within a few cycle-years. Historical records indicate that the Gates Creek run was always relatively unimportant in the three intervening cycles.

The second native sockeye population produced in the district migrated through the river fishery in mid-September to spawn in Portage Creek, a short

FIGURE 1.—Seaward-migrant fence at the outlet of Chilko Lake. The three towers are photographic stands from which pictures of the moving migrants are taken every 5 minutes to determine the seasonal total. In 1954 over 6,000,000 migrants passed through the fence openings in 7 hours.

stream joining Anderson and Seton Lakes. This run was likewise seriously disturbed by hatchery operations prior to 1913 and also by the 1913 Hell's Gate block. A combination of a few pairs of residual native spawners and a planting of eyed eggs originating from the Late Adams run of 1950 returned a spawning population of 3505 sockeye to this stream in 1954. Returning runs to Gates Creek of significant size may be expected in future years on the 1912-1952 cycle and of lesser size to Portage Creek on the 1914-1954 cycle. Total productivity of the district could possibly reach 1,000,000 sockeye for each four-year period. It should be noted, however, that it has not been established that two cyclical dominant runs can occur in separate years in the same watershed.

Thompson River District

The original runs of sockeye to this area were equal to, or at least approached, the size of the runs produced by the Quesnel district. The early migrating sockeye spawned principally in Upper Adams River draining into Adams Lake, and in the smaller tributaries of Shuswap Lake. Two small runs of the early migrating population spawned in the Raft and Barriere Rivers, both tributaries of the North Thompson River, and the resultant fry utilized Kamloops Lake as a rearing area. The late migrating populations spawned in the Lower Adams River, Little River, South Thompson River and Shuswap River.

All the early populations were seriously affected by the Hell's Gate blockade but even before 1913 the population spawning in the Upper Adams River had been injured by a logging dam constructed in 1908. The result was that this sizable population became extinct as did several other early spawning populations, including those spawning in Salmon River and Eagle River. The Barriere population was similarly almost exterminated by a combination of the Hell's Gate blockade and a series of power-dams constructed without adequate fishways. The Barriere dams have now been removed and a residual population of 108 spawners was observed in 1951 (1915-1955 cycle). It is expected that this number of spawners will increase and that with plants of eyed-eggs from Raft River to re-establish the now barren annual cycles this stream will eventually return to full production. Eggs can be obtained from Raft River as the sockeye production in this stream has gradually increased since the construction of the Hell's Gate fishways and already seems to be approaching its maximum.

The observation of 205 spawners in the Upper Adams River in 1954 showed that the transplantation of eyed-eggs from the Seymour River in 1950 was successful. Eyed-egg transplants will be made for each of the four cycles until annual runs are again produced in this important stream. Records of the size of the population produced by Upper Adams River and the related Adams Lake rearing area before 1913 are too obscure to enable the actual size of the original population to be assessed but it is believed that adequate spawning and rearing grounds are available to produce several million sockeye a year for one cycle out of the four. The logging dam has been removed and future rehabilitation now depends on the successful adaptation of the transplanted Seymour River sockeye to their new reproductive environment.

The early run to Seymour River has responded successfully to the benefits of the Hell's Gate fishways and the sizable run that now occurs each year is capable of supplying eyed-eggs for any required transplants to now barren neighbouring spawning areas. Scotch Creek at the outlet of the Shuswap Lake has a small population on the original 1913 cycle (1913-1957) but no fish remain from the populations of the other three cycles. It is probable that transplants from the Seymour River will be needed in this stream to re-establish runs in the three barren years. It may be necessary to synchronize the dominant year of production in the tributary streams of Shuswap Lake with that of the late run of sockeye to this area, which was apparently completely re-established in 1954 (1914-1954 cycle).

The late run, because of its time of migration up the Fraser River, was the least affected by the Hell's Gate obstruction of all the sockeye populations of the upper Fraser River. With the cessation of operations by the logging dam in 1922 the late-sockeye population increased at a rapid rate until it reached an all-time record figure of 10,000,000 sockeye in 1954. It is not anticipated that this population can be substantially increased.

Any significant future increases in sockeye populations produced by the Thompson River tributaries will probably originate in the Upper Adams River and in the Barriere River. Both of these streams are associated with rearing areas not affected by the current large population being produced in Shuswap Lake. On which annual cycle these potential increases will occur must remain undetermined until production increases substantially over that existing at present.

Lower River District

Production of sockeye spawning in the tributary streams below Hell's Gate has been unaffected by the Gate but the annual pattern is obscured by variable, and sometimes large, numbers of five-year-old fish that appear in the runs to this area. Quadrennial dominance in most of these sockeye populations, if it exists at all, is indistinct because of the variable year classes, not yet assessed in size, which make up each annual population. The Lower River runs of sockeye have contributed an important part of the Fraser River sockeye catch each year and little change in the magnitude of this contribution is expected in future years.

In summarizing the information for all districts as outlined above and in interpreting its detailed effect on the catch of future years, special consideration must be given to the vagueness of the historical records respecting the size of individual annual runs. Attention must also be paid to the normal fluctuations in productivity resulting from local or temporary environmental variations; these will cause catches to vary from cycle to cycle regardless of the efficacy of the management policies. Thought must be given to the possibility that quadrennial productivity patterns forming at present may change so that they are properly synchronized with variable annual ecological cycles in the reproductive and rearing areas, if such cycles exist.

The greatest possibility for increased catches is on the 1913-1957 cycle. The Quesnel and Stuart River runs show clear indications that they will be dominant

on this cycle and in both areas as rehabilitation has only started; the potential maximum is yet to be reached. If the existing residual runs are capable of rapid adjustment to the different environment of the once-important but now barren spawning grounds total cyclic catches should, in a relatively short period of time, exceed 10,000,000 sockeye. The formation of dominant productivity of the Nadina run on this cycle will also add to future catches. Irrespective of how long the Stuart and Quesnel runs require for proper adjustment to the varied reproductive environment future catches are expected to increase over those obtained in 1953, the last cycle-year.

As runs originally dominant on this cycle have shifted their dominant year to other cycles, the production in 1913 and in the previous years of the cycle can never be regained. The change of dominance from one cycle to another will increase the catch of the original "off-years" resulting in a desirable increased uniformity in the total production for each year.

The 1914-1958 cycle run appears to have reached a size in 1954 which it will be difficult to exceed in future years. In fact, the catch in 1954 exceeded that of any cycle-year in the history of the Fraser River fishery. The Late Adams run is dominant on this cycle and the productivity pattern of the Stellako run is now such that the large 1954 run to this area appears to be permanently established. The normal cyclical variation in the collective productivity of these two runs may be greater than any changes which may occur in the productivity pattern of smaller runs contributing to the catch of this now important cycle.

The 1915-1955 cycle has always been one of the two poorest of the four cycles and it appears that it will continue to be so in future years. Currently, the sub-dominant Chilko and Adams River runs are the mainstay of the potential catch and there is no indication that any newly revived run will be created to greatly augment catches from the existing runs. The catch in 1951 exceeded that of any cycle year since 1903.

The 1916-1956 cycle catch is now provided principally by the dominant run to Chilko Lake. Since it is believed that the 1948 and 1952 runs to Chilko were below the potential dominant run for this area some increase in the cycle catch of future years may be expected under favorable conditions. The Gates Creek run is rapidly increasing on this cycle and may add significantly to the cycle catches of future years. In spite of these increases this cycle and the 1915-1955 cycle will remain smaller than the other two cycles.

The potential of the Upper Adams River run appears so great that, if and when it is restored, it should have a decided effect on the catch of whichever cycle eventually contains the dominant run. Attempts will be made in transplanting experiments to start new annual runs in such a manner that the dominant run will occur on one of the two weak cycles; however, physical and biological conditions may interfere with the success of this plan.

TABLE I

SOCKEYE CATCH BY GEAR

United States Treaty Waters

Year	Purse Seines			Gill Nets			Reef Nets			Total Catch
	Units	Catch	Percentage	Units	Catch	Percentage	Units	Catch	Percentage	
1942	152	2,761,457	94.08	52	36,868	1.26	48	136,867	4.66	2,935,192
1946	168	3,366,755	94.80	58	50,440	1.42	58	134,111	3.78	3,551,306
1950	288	1,061,480	86.94	205	82,854	6.79	96	76,559	6.27	1,220,893
1954	297	3,764,949	78.34	447	861,895	17.93	74	179,414	3.73	4,806,258

Canadian Treaty Waters

Year	Purse Seines			Gill Nets			Traps			Total Catch
	Units	Catch	Percentage	Units	Catch	Percentage	Units	Catch	Percentage	
1942	—	2,051,653	40.65	1337	2,895,481	57.36	5	100,465	1.99	5,047,599
1946	132	1,646,689	38.84	1843	2,555,955	60.27	5	37,554	0.89	4,240,198
1950	113	371,140	41.49	1048	483,603	54.07	5	39,726	4.44	894,469
1954	236	2,410,564	51.04	1798	2,265,335	47.97	3	32,822	0.70	4,722,463*

* Includes 13,742 troll caught sockeye.

NOTE: Gear counts represent the maximum number of units delivering on any single day.

Table II

CYCLIC LANDINGS AND PACKS OF SOCKEYE

	United States	*Canada*	*Total*
*1954			
Total Landings (No. Sockeye)	4,806,258	4,722,462	9,528,720
Share in Fish	50.44%	49.56%	
Total Pack (48 lb. Cases)	501,496	486,805**	988,301
Share in Pack	50.74%	49.26%	
1951-1954			
Total Landings (No. Sockeye)	9,088,961	9,157,350	18,246,311
Share in Fish	49.81%	50.19%	
Total Pack (48 lb. Cases)	912,608	913,116	1,825,724
Share in Pack	49.99%	50.01%	
1947-1950			
Total Landings (No. Sockeye)	3,455,002	3,022,994	6,477,996
Share in Fish	53.33%	46.67%	
Total Pack (48 lb. Cases)	294,206	252,959	547,165
Share in Pack	53.77%	46.23%	
1954 *Cycle Pack*			
1954	501,496	486,805	988,301
1950	116,458	81,510	197,968
1946	280,018	331,292	611,310
1942	263,458	426,979	690,437
1938	134,641	186,794	321,435
***1934	352,579	139,238	491,817
1930	352,194	103,692	455,886
1926	44,673	85,689	130,362
1922	48,566	51,832	100,398
1918	50,723	19,697	70,420
1914	335,230	198,183	533,413
1910	248,014	150,432	398,446
1906	182,241	183,007	365,248
1902	339,556	293,477	633,033
1898	252,000	256,101	508,101
****1894	41,300	360,000	401,300
1890	—	225,000	225,000
1886	—	36,000	36,000

*19 Canneries in the United States and 12 canneries in Canada received the sockeye caught in Convention waters.

**Including 6,234 cases packed in the United States.

***1898 to 1934 from Pacific Fisherman, 1948 Yearbook Number, p.139.

****1886 to 1894 from Rounsefell and Kelez, The Salmon and Salmon Fisheries of Swiftsure Bank, Puget Sound, and the Fraser River, U.S. Bureau Fish. Bull. 27, 1938.

COMMISSION MEETINGS

The *first* meeting of the International Pacific Salmon Fisheries Commission during the year 1954 was held on January 7 and 8 in Vancouver, B.C. On the opening day the Honourable James Sinclair, M.P., Minister of Fisheries for Canada, together with all members of the Advisory Board and guests heard a review of the 1953 fishing season and a summary of prospects for the 1954 season.

Tentative recommendations by the Commission staff for the 1954 sockeye fishing regulations in Convention waters were distributed with explanatory comments to members of the Advisory Board. In accordance with accepted procedure no further action was taken beyond distributing the recommended regulations, all discussion being postponed to a later meeting to allow members of the Commission and the Advisory Board time for study and analysis of the proposals. Members of the Advisory Board present were: for Canada, Mr. Morgan Berg, troll fishermen; Mr. M. W. Black, sport fishermen; Mr. R. Nelson, salmon canners; Mr. P. Jenewein, gill net fishermen; and Mr. H. A. Christenson acting for Mr. William Pitre, representing purse seine fishermen. For the United States, Mr. John Brown, troll fishermen; Mr. Howard Gray, sport fishermen; Mr. Chester Karlson, gill net fishermen; Mr. N. Mladinich, purse seine fishermen; and Mr. J. N. Plancich, salmon canners.

The *second* Commission meeting of 1954 was held at Bellingham, Washington on March 12 and 13. The Commission heard staff reports dealing with research on the problems of sockeye management and with the problems of environmental protection necessitated by industrial developments on the Fraser River watershed. All members of the Advisory Board were present to offer their views on the proposed regulations for 1954. The representations of the Board members were heard and discussed by the Commission, and revised recommendations for regulations were later prepared and approved by the Commission for forwarding to the respective governments.

The *third* Commission meeting of the year was held on July 9 and 10 at Harrison Hot Springs, B. C. Staff members presented reports covering the most important problems of research and management involved in the Commission's fulfillment of its duties under the Treaty. Subjects surveyed included the following: 1. Determination of the racial composition of daily sockeye catches and its relevance in the scientific regulation of the fishery; 2. Calculating escapement from the daily sockeye catch statistics; 3. Migration rates of various runs of sockeye; 4. Selective action of gill nets for age, size, and sex of sockeye and its effect on the productivity of the escapement; 5. Relationship of physical characteristics of spawning streams to the spawning and survival of sockeye populations; 6. The establishment and maintenance of dominance in sockeye populations; 7. Methods for controlling the movements of upstream and downstream migrant sockeye; 8. Numerical relationship of sockeye spawners, eggs, fry and yearlings at Chilko Lake; 9. Effects of stream temperatures on the spawning and reproduction of sockeye; 10. Stream pollution arising from increased industrial development on the Fraser River watershed; 11. Design, construction and operation of an artificial spawning ground for sockeye.

The budget estimates for the 1955-1956 fiscal period were reviewed and approved for submission to the sponsoring governments.

A decision was made not to undertake further hatching and transplantation operations at the Quesnel Field Station before the completion of the experiments that were already under way.

Six emergency meetings were required to deal with regulatory problems arising during the 1954 sockeye fishing season. These meetings were held in New Westminster, British Columbia on July 22; In Bellingham, Washington on August 13; in New Westminster, British Columbia on August 29; in Seattle, Washington on September 4; in New Westminster, British Columbia on September 17 and in New Westminster, British Columbia on September 23 at which time it was agreed to relinquish control of all sockeye fishing for 1954 at 6:00 p.m. on September 25.

Members of the Advisory Board were requested to be present at the meeting held in Seattle, Washington on September 4. Canada was represented by Mr. R. Nelson, Mr. P. Jenewein, Mr. M. W. Black, and Mr. H. Stoelen acting for Mr. William Pitre. The United States was represented by Mr. Chester Karlson, Mr. John Brown, Mr. J. N. Plancich, and Mr. N. Mladinich.

At its *tenth* and final meeting of the year, held in Bellingham, Washington on December 6 and 7 the Commission welcomed a new member for the United States, Mr. A. J. Suomela, replacing Mr. A. M. Day. The Director and members of the staff presented reports summarizing the operations of the 1954 season. Staff recommendations for 1955 sockeye regulations together with supporting data were presented to the Commissioners and the members of the Advisory Board. Advisory Board members present representing Canada were: Mr. R. Nelson, salmon canners; Mr. William Pitre, purse seine fishermen; Mr. M. W. Black, sports fishermen and Mr. P. Jenewein, gill net fishermen. Those representing the United States were: Mr. J. N. Plancich, salmon canners; Mr. N. Mladinich, purse seine fishermen; Mr. Chester Karlson, gill net fishermen and Mr. H. Gray, sports fishermen.

1954 REGULATIONS

Recommendations for regulations governing the management of the sockeye fishery were considered and adopted at a meeting of the Commission held with its Advisory Committee in Bellingham, Washington, on March 13, 1954.

The recommendations for regulations, as approved by the Commission, were transmitted to the Departments of Fisheries of Canada and of the State of Washington and to the Secretary of the Interior at Washington, D. C. The recommendations were accepted in substance for Canadian waters by an Order-in-Council adopted on June 10, 1954, and for the United States waters by an Order of the Director of the Washington State Department of Fisheries promulgated May 10, 1954.

The recommendations of the Commission were as follows:

Canadian Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, hereby recommends to the Honourable the Minister of Fisheries that Regulations to the following effect, in the interests of such fisheries, be adopted by Order-in-Council as amendments to the Special Fishery Regulations for British Columbia, for the season of 1954, under the authority of the Fisheries Act, namely:

1. That in the waters of District No. 1 and in those waters of the southern portion of District No. 3 bounded on the west by the Forty-ninth Parallel, projected from the Vancouver Island shore in the vicinity of Florencia Bay (excepting all the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale and all the waters of Nitinat Lake and entrance thereto) and bounded on the north by an imaginary straight line drawn from Welcome Point to Sechelt Peninsula, thence along an imaginary straight line drawn to Point Young on Lasqueti Island, thence along an imaginary straight line drawn to Dorcas Point on Vancouver Island, no one shall buy, sell, or have in his possession any sockeye salmon taken in those waters during the time fishing for such salmon is prohibited therein.

2. That in the waters of the said southern portion of District No. 3 embraced in Areas 19, 20, 21 and 23, but not including all the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, commencing on the 24th day of June 1954 and continuing until the 30th day of August 1954 there shall be weekly closed periods of 48 hours duration.

3. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 and in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, commencing on the 24th day of June 1954 and continuing until the 4th day of August 1954 there shall be weekly closed periods of 78 hours duration and commencing on the 4th day of August and continuing until the 25th day of August 1954 there shall be weekly closed periods of 96 hours duration and for the weekend immediately following the 25th day of August 1954 there shall be a weekly closed period of 78 hours duration, and commencing on the 1st day of September 1954 and continuing until the 16th day of September there shall be weekly closed periods of 48 hours duration; in that part of District No. 1 above Pattullo Bridge the weekly closed periods shall commence as above specified but shall cease 4 hours later than that specified for the remaining waters of District No. 1 and all of the waters of Areas 17 and 18 of District No. 3.

4. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 and in the waters of District No. 1 no one shall fish for or take sockeye salmon commencing at 8:00 a.m. on the 16th day of September 1954 and continuing until 8:00 a.m. on the 27th day of September 1954 except that fishing for a period of 24 hours may be permitted with nets of not less than 8½ inches stretched measure if such fishing shall be deemed necessary by the Department of Fisheries for an adequate harvest of spring salmon.

5. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 and in the waters of District No. 1 control by

the International Pacific Salmon Fisheries Commission of fishing for sockeye salmon shall continue until midnight on October 14th, 1954, notwithstanding the fact that no specific closures in addition to those normally in force by virtue of the Special Fishery Regulations for British Columbia are herein recommended to be in force during the period commencing at eight o'clock in the forenoon of September 27th and continuing until midnight on October 14th, 1954.

6. That the Chief Supervisor of Fisheries for British Columbia, consistent with authority vested in him, may implement recommendations which may be made by the International Pacific Salmon Fisheries Commission respecting additional close times for fishing for sockeye salmon in waters of District No. 1, and in those waters of the southern portion of District No. 3 described in section one hereof by posting a notice of any additional close time so recommended on the cannery or canneries adjacent to the area or areas thereby to be affected at least twenty-four hours before the commencement of such additional close times.

7. That nothing contained herein shall apply to the taking of sockeye salmon in the waters of District No. 1 and in those waters of the southern portion of District No. 3 described in section one hereof by the International Pacific Salmon Fisheries Commission or its duly authorized representatives.

On the recommendation of the International Pacific Salmon Fisheries Commission modifications were made in the 1954 regulations governing sockeye fishing in Canadian Convention waters that had been approved by the Order-in-Council referred to above.

Because of a strike by the Salmon Tendermen which resulted in a complete tie-up of the Canadian fishing fleet during the period August 6 to August 16, the weekly closed time beginning August 13 was reduced by twenty-four hours for the waters of District No. 1 below Pattullo Bridge and in Areas 17 and 18, and by twenty-eight hours for the waters of the Fraser River above Pattullo Bridge. The purpose of the reduction in the weekly closed time was to allow a maximum exploitation of those races which had already experienced adequate escapement during this tie-up period.

An unusual concentration of sockeye in the Strait of Georgia, and especially in the lower portion of Area 18, coinciding with the presence of an active purse seine fleet estimated at over 300 boats, necessitated the closure of Areas 17, 18 and 19 from 12:01 a.m. on August 31 for purse seines and from 8:00 a.m. on August 31 for gill nets until 6:00 p.m. on September 25 at which time the Commission relinquished control of sockeye in Canadian Convention waters.

After regulatory control by the Commission ended at 6:00 p.m. on September 25, the Chief Supervisor of Fisheries implemented special regulations that would allow the remaining quantities of late sockeye to be caught at once, to assure the best possible quality for commercial utilization.

Gill nets were permitted to operate in District No. 1 and those portions of Areas 17 and 18 lying in the Gulf of Georgia from 6:00 p.m. Saturday, September 25 to 8:00 a.m. Friday, October 1. Purse seines were allowed to operate from 6:00 a.m. to 6:00 p.m. on each day from September 27 to 30 inclusive in those portions of Areas 17 and 18 lying in the Gulf of Georgia and

in that part of District No. 1 lying outside of Howe Sound and Burrard Inlet and westerly of a line drawn from the outer range marker on the International Boundary to the Canoe Pass buoy; thence to Roberts Bank buoy; thence to the Sandheads Lightship; thence to the most westerly extremity of the Steveston jetty.

The statutory weekly closed times of the Department of Fisheries were in effect in District No. 1 from October 1 until the closure to salmon net fishing at 8:00 a.m. November 26, with the exception of one 48-hour extension of the weekly close time on November 16. This was the first year that the early closure of the commercial area above Pattullo Bridge was in effect, this closure being applied at 8:00 a.m. October 8.

United States Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, hereby recommends to the Director of Fisheries of the State of Washington that regulations to the following effect, in the interests of such fisheries, be adopted by him by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. That in the waters of the United States of America embraced in Article I of the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, there shall be weekly closed periods for all gear of forty-eight hours duration commencing on June twenty-fourth, 1954 and continuing to and including September sixth, 1954. The said weekly closed periods for Purse Seines and Reef Nets shall commence at 12:01 a.m. Saturday of each week and continue until 12:01 a.m. on the Monday following, and for Gill Nets the said closed periods shall commence at 6:00 p.m. Friday of each week and continue until 6:00 p.m. on the Sunday following.

2. That in the waters of the United States of America embraced in Article I of the said Convention control by the International Pacific Salmon Fisheries Commission of fishing for sockeye salmon shall continue until midnight September thirtieth, 1954, notwithstanding the fact that no specific closures are herein recommended to be in force during the period commencing on September sixth, 1954 and continuing until September thirtieth, 1954.

3. That in the waters of the United States of America embraced in Article I of the said Convention it shall be unlawful for anyone to buy, sell or have in his possession sockeye salmon taken during the times when fishing for or taking sockeye salmon is prohibited therein.

4. That nothing contained in any rules or regulations relating to fishing for or taking sockeye salmon shall apply to the taking of sockeye salmon within the waters of the United States of America embraced in Article I of the said Convention by the International Pacific Salmon Fisheries Commission or its servants or agents acting pursuant to its directions for the purpose of exercising its objects under the said Convention.

5. That the Commission further recommends that the Director of Fisheries for the State of Washington consistent with authority in him vested implement recommendations which may be made by the International Pacific Salmon Fisheries Commission, through its Chairman, respecting additional closed periods for fishing for sockeye salmon in those waters of the United States of America embraced in Article I of the said Convention.

The approved regulations as detailed above were in effect throughout the sockeye fishing season except as altered by one closure and two extensions in an effort to fulfill the requirements of the Sockeye Fisheries Convention. On July 22 the American catch was almost double the Canadian catch and a twenty-four hour extension of the weekly close time was recommended. On August 22 when it appeared that the American catch of Adams River sockeye would be below its fair share the weekly close time was reduced by twenty-four hours. A further reduction of twenty-four hours in the weekly close time was necessary on August 29. In the interests of escapement and in line with the existing closure in the adjoining Canadian waters the waters westerly of a line from Point Roberts light to Patos Island light were closed for the period September 4 to 20.

High Seas

Under the authority of the Convention hereinafter mentioned, the International Pacific Salmon Fisheries Commission at its meeting in Bellingham, Washington, on the thirteenth day of March 1954, made and adopted the following order and regulation, namely:

"taking Sockeye Salmon on the High Seas described in paragraph numbered 1 of Article I of the Convention between the United States of America and the Dominion of Canada for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, is hereby prohibited from midnight Friday to midnight Sunday during each weekly period between June 24th and August 30th, both dates inclusive in the year 1954; provided that this order and regulation shall apply only to nationals and inhabitants and vessels and boats of the United States of America and the Dominion of Canada: this Order and Regulation being affirmatively voted for by at least two of the Commissioners of each High Contracting Party."

Patrol agencies of both the United States and Canada provided adequate equipment and officers for the enforcement of the High Seas regulation protecting the Fraser River sockeye. No violations were reported.

THE UNITED STATES FISHERY

The continued increase in the number of units of fishing gear in United States waters was particularly evident in the month of July when the early runs were passing through the fishery. A comparison of the 1942 and the 1954 cycle catches and the fishing effort for each gear illustrates the almost phenomenal increase in the gill net fishing effort as well as the increase in the size of the July run that has occurred in the short period of twelve years.

Comparison of 1942 and 1954 United States Sockeye Catches for July

					% Increase of 1954 over 1942		
		Total Unit Days	*Total Catch*	*Total Catch per Unit Day*	*Unit Days*	*Catch Per Unit*	*Total Catch*
Purse Seine	1942	1385	115,818	836.2			
	1954	2423	270,460	1116.2	74.95	33.48	133.52
Reef Net	1942	302	9,512	31.5			
	1954	853	47,666	55.9	182.45	77.46	401.11
Gill Net	1942	335	5,003	14.1			
	1954	5527	177,987	32.2	1456.90	128.37	3457.61

In addition to the increase in fishing intensity the fishing efficiency of individual gill nets changed appreciably in 1954 over that of previous cycles because of a change-over from linen to nylon nets. Purse seines using drums were in operation for the first time on this cycle although their effectiveness remains in doubt, at least on the dominant Adams River run. The prime consideration in the development of the drum seines is a contemplated increase in the individual fisherman's income because a smaller crew is required.

The Adams River run, which was the main contributor to the 1954 catch, apparently varied from normal in two ways. One unusual feature was that for a time the migration departed from the usual channels and passed up the west side of the San Juan Island, remaining almost exclusively in Canadian waters. Catches on the days when the migration followed this abnormal pattern consisted almost exclusively of drifting fish caught along the International Boundary from Stuart Island to Point Roberts. The other abnormality of the Adams River run, was its arrival in two waves. The first wave made up only about 10 per cent of the total run and appeared early in the season, passing through the United States fishery between August 5 and 15. The second wave was later than normal, occurring between about August 25 and September 3.

A detailed record of the cycle catches of sockeye in United States Convention waters for the years 1942, 1946, 1950 and 1954 is included in Table III.

THE CANADIAN FISHERY

Several new circumstances affected the Canadian fishery in 1954. A marked increase in purse seine fishing effort over that of previous cycles occurred in the Sooke-San Juan area, the greatest increase being registered in the San Juan area. In past years fishing by gill nets in the Sooke-San Juan area has been restricted

FIGURE 2.—Aerial view showing concentration of United States purse seine fleet at Point Roberts during the height of the 1954 Adams River run.

Table III

DAILY CATCH OF SOCKEYE 1942-1946-1950-1954 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1942	1946	1950	1954	1942	1946	1950	1954	1942	1946	1950	1954
1	30			1,332	436	10,851	15,403		180,185	53,804	343	472,636
2				6,000	13,845	8,930	20,880	31,848	118,421	131,748	42	446,988
3	58				11,844		25,058	40,479	10,618	92,579	16	173,977
4	14				12,727	12,163		40,377	906	71,241	3	
5	585			16,232	14,723	7,745		29,883		62,452	18	
6	105			8,509	21,753	15,543	16,961	35,902	378	79,725		117,704
7	563			6,623	24,290	34,751	34,588		7,262		968	115,016
8	225			12,660		47,971	48,134		589	41,085	713	66,966
9	588			8,676	20,550	38,902	41,470	93,065	787	94,111		71,330
10	1,596				23,806		36,990	107,428	4,455	103,522	207	42,100
11		CLOSED	CLOSED		32,832	23,838		91,372	4,070	92,895	393	10,441
12	2,976			22,095	36,887	23,799		97,970		13,347	297	7,646
13	1,977			18,854	46,301	29,522	55,865	46,821	33	7,562	56	8,952
14	939			10,979	40,801	35,193	26,563		13		62	8,796
15	155			10,248		34,903	18,115		13	8,342	46	10,409
16	1,652			12,450	17,384	43,047	36,042	37,003	20	8,599		2,412
17	1,579				24,075		52,889	74,421	144	21,893	898	1,229
18					52,395	27,381		39,791	124	9,173	483	635
19	4,220			38,708	74,633	43,713		28,893		11,005	2,427	397
20	2,874			30,461	88,366	63,070	138,217	58,738	77	705	365	1,328
21	10,993			27,871	162,510	64,503	153,568		250		124	1,399
22	5,232			24,719		55,089		91,515	106	4,882	67	1,239
23	9,551			32,768	263,589	54,416	100,173	114,790	130	2,197		457
24	7,219				251,749		131,748	84,516	3,002	1,696	12	308
25		305			192,006	89,452	107,788	135,827	773	1,846	21	24
26	12,747	87		1,325	159,915	134,956		167,812			14	358
27	7,930			75,112	302,628	290,642	83,504	233,032	1,350	CLOSED	17	401
28	17,316	172		51,961	150,166	542,836	38,212		15,418		18	430
29	12,500	321		43,253		366,879		406,321	16,468		11	159
30	17,542	189		35,277	59,360	531,426	16,818	292,094	26,608			96
31	9,167	4,302	14,286		280,408			359,913				
Totals	130,333	5,376	14,286	496,113	2,379,979	2,631,521	1,198,986	2,739,811	392,200	914,409	7,621	1,563,833
June Total												6,033
October Total									32,680	4		468
Season Total									2,935,192	3,551,310	1,220,893	4,806,258

Table IV

DAILY CATCH OF SOCKEYE, 1942-1946-1950-1954 FROM CANADIAN TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1942	1946	1950	1954	1942	1946	1950	1954	1942	1946	1950	1954
1	3,020			2,204	257	946	25,874		102,430		312	91,065
2	2,277			252		947	26,390	152,661	170,801	67,498		152,331
3	4,054				18,857		30,775	72,581	202,875	146,709	120	120,485
4					8,899			34,608	164,307	190,107	19,760	
5				14,601	7,276	72		58,230		144,135	12,062	9,963
6	12,080			10,426	6,169	230	11,031	37,383		93,529	26,320	166,818
7	8,995			7,711	8,744	71	53,074		127,307		978	128,713
8	8,877			7,839		14,075	31,653		269,416		150	96,413
9	6,950			527		7,475	20,121	423	416,793	120,686		101,374
10	5,267				37,239		21,189	3,742	284,200	84,121	307	148,585
11		CLOSED	CLOSED		20,035		296	3,897	315,568	599,942	50	
12				9,667	14,224	61,254		4,710		80,620	50	
13	8,774			8,448	21,446	29,700	14,679	1,432		312,505	58	206,257
14	2,533			7,200	21,348	21,513	49,953		559,614		16	151,204
15	6,534			7,159		16,307	29,973		688,050		16	180,631
16	5,264			1,938		18,042	32,366	108,875	85,579	327,366		85
17	4,623				45,661		38,300	92,754		218.704	16	569
18					25,344			80.512		162,323	15	901
19				18,838	43,370	53,008		57,100		151,372	15	904
20	14,721			13,149	33,322	22,382	71,775	8,188		82	15	356
21	6,664			10,963	48,105	22,574	42,085		1,730		10	606
22	9,316			16,266		27,513	29,217		217		8	313
23	8,112			9,088		33,499	45,742	159,874	1,547	356,118		307
24	6,827				102,677		52,525	235,418		202,150	2	97
25		275			86,859		21,972	213,529		25	29,233	47,355
26	7,708	275		71,681	64,779	165,805		539,766		CLOSED	10,835	15,658
27	7,312			41,923	76,335	324,065	3,118	265,506			10,663	10,204
28	7,875			33,239	70,688	89,112	40,252		3,775		4,980	19,086
29	10,257	187		33,734		36,545	19,577					9,287
30	11,670	188		17,754		29,361	13,918	520,223				4,435
31		188	31,679		86,985		7,737	48,515				
Totals	169,710	1,113	31,679	344,607	848,619	974,496	733,592	2,699,927	3,394,209	3,257,992	115,991	1,664,002
8" Gill Nets		1,027				1,126						
May & June Totals	2,042	575	2,042	7,997								
Oct. & Nov. Totals									633,019	3,869	11,165	5,987
Season Total									5,047,599	4,240,198	894,469	4,722,520

TABLE V

THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1950, 1954

	1950		1954	
District and Area	*Catch*	*No. of Fishermen*	*Catch*	*No. of Fishermen*
HARRISON-BIRKENHEAD				
Skookumchuck and Douglas	846	9	1,045	
Lillooet Lake	—	—	385	
Birkenhead River	5,992	22	3,501	
TOTALS	6,838	31*	4,931	38*
LOWER FRASER				
Laidlaw to Vedder River	—	—	2,870	
Seabird Island and Adjacent Area	—	—	3,745	
Katz and Ruby Creek	—	—	625	
TOTALS	—	—	7,240	182*
CANYON				
Union and American Bars	896	16	908	
Yale	4,366	19	5,897	
Spuzzum	1,632	14	940	
Lower Gorge	—	—		
Upper Gorge	—	—		
Boston Bar	766	14	1,048	
Boothroyd	834	23	1,939	
Cisco	3,153	62	5,360	
TOTALS	11,647	148	16,092	234*
LYTTON-LILLOOET	6,285	—		
Gates Creek	—	—	—	
TOTALS	6,285	—		—
BRIDGE RIVER RAPIDS				
Lillooet	3,770	—		
Rapids	8,685	—		
Pavillion	985	—		
TOTALS	13,440	152*	20,125**	174*
CHILCOTIN				
Farwell Canyon	15	—	1,299	11
Hance's Canyon	111	—	976	10
Martins	37	—	21	5
Anahim	—	—	—	
Alexis Creek	150	—	1,327	10
Siwash Bridge	470	—	2,240	21
Keighley Holes	250	—	195	6
Henry's Crossing	—	—	—	
TOTALS	1,033	59*	6,058	63
UPPER FRASER				
Shelley	—	—	171	8
Alkali and Canoe Creek	300	23	450	21
Chimney Creek	2,110	33	1,489	31
Soda Creek	513	17	594	14
Alexandria	251	5	56	2
Quesnel	525	5	210	4
TOTALS	3,699	83*	2,970	80*
NECHAKO				
Nautley Reserve	3,205	17	1,026	9
Stella Reserve	2,569	21	1,297	10
Nadina	—	—	—	—
TOTALS	5,774	38*	2,323	19*
STUART LAKE				
Fort St. James	2,688	48	2,743	35
Tachie Reserve and Pinchi	—	35	1,704	22
Trembleur and Takla Lake	2,863	5	243	3
TOTALS	5,551	88*	4,690	60
THOMPSON				
Nicomen Creek	—	—	5,655	
Ashcroft	—	—	2,750	
Deadman's Creek	—	—	—	
North Thompson River	—	—	200	
South Thompson River	16,528	42	21,500	
TOTALS	16,528	42	30,105	155*
GRAND TOTALS	70,795		94,534	

*Number of Permits issued to Indians in District.
**Number includes Lytton to Lillooet catch.
The Indian catch statistics detailed above are obtained principally from the Fisheries Inspectors of the Canadian Department of Fisheries. These inspectors control the taking of sockeye for food by the various Indian populations residing throughout the Fraser River Watershed.

to sporadic, almost "experimental," operations but in 1954 101 gill net boats were operated effectively in these "offshore" grounds, 55 of them fishing in the San Juan area alone. The efficiency of this new fishing fleet was always good, often excellent and, as a result, a greatly augmented gill net fishery in this area is expected in future years.

One of the vagaries of the 1954 Fraser River sockeye season in Canadian waters was the almost complete failure of the runs to approach the Fraser River through Johnstone Strait. This circumstance, combined with an unusual concentration in Area 18 of drifting sockeye of Adams River origin, brought about an unprecedented intensity of fishing effort in that area on August 30. On this date an estimated total of 300 purse seine boats entered Area 18 and 236 landings were made for a total catch of 465,000 sockeye. Such a high degree of effectiveness by such a large number of boats necessitated an immediate closure of the area.

The number of gill net boats that fished the Fraser River area during the normal delaying period of the Adams River migration was also large, a maximum of 1798 units in a single day was recorded. Almost all of them were using nylon nets for the first time on this cycle; the effectiveness of the nylon nets over that of linen nets is now tentatively estimated at over 100 per cent for the Straits of Georgia area adjacent to the river mouth, where the majority of the boats operated. The lack of a prior measure of the efficiency of the nylon nets combined with an unexpected speed of departure of the fish for their spawning grounds resulted in the excessive number of sockeye on the Adams River spawning grounds. The spawning migration started at a point one mile above Steveston at about 3:00 p.m. on September 16 and within three days it was almost completed. Only 105,958 sockeye were taken in September after the season opened on September 25 and only 5643 sockeye were taken in October compared with 627,443 caught in October 1942, one of the previous cycle years when a similar large run occurred.

A detailed record of the cycle catches of sockeye in Canadian Convention waters for the years 1942, 1946, 1950 and 1954 is included in Table IV. The effect of the tie-up in the entire Canadian fishing fleet from August 6 to 16 through a Tendermen Strike will be observed in the 1954 catch figures.

ESCAPEMENT

Research during recent years into the requirements of a highly productive escapement has in all cases indicated the greater importance of the character rather than the numerical size of the spawning stock. For the Chilko, Adams, and Stellako escapements a tentative maximum size has been set, since the runs to these areas now appear to be approaching their maximum size. The figures established may be subject to future correction if additional data indicate the need for such correction. As they stand at present the figures of 400,000-450,000 sockeye set as the optimum escapement for Chilko in the "big year," and the similar 150,000-175,000 for Stellako and 1,000,000 to 1,500,000 for Adams are far below the actual escapement to each area in certain recent years. In no

case did the excessive escapement in these years result in an increased size of the returning run; rather a small decline was usually noted.

If a reduction can be made in the size of the escapement the improved economy of the industry that will result from this reduction is rather startling. In 1942 the Adams River escapement exceeded the considered optimum by approximately 1,000,000 sockeye. This excessive escapement represented an unnecessary loss of $1,500,000 to the fishermen, based on the average weights of that year and on 1954 prices, or a loss to the region of approximately $3,000,000, the value of the canned product. There is some indication that excessive escapements actually cause a decline in the returning run. If this is true additional losses must be added to those already detailed. The economic importance of carefully controlled escapements appears to be so great that careless fishery management practices cannot be tolerated after the needs of good management have been determined by research; the economic justification for such research is certainly obvious.

The management of the complicated Fraser River sockeye fishery to obtain a desired optimum escapement is difficult but not impossible under favorable operating conditions. The desired escapement is obtained by using daily catch statistics weighted by the intensity of the fishery and adjusting the catch through regulatory restrictions as soon as the catches indicate any variation from the expected total size of the run. The escapement needs of other smaller runs of sockeye migrating at the same time complicate the problem of controlling the catch and escapement of the larger run, which is economically more important, but they are not of sufficient importance to eliminate the economic advantages resulting from such a control.

The justifiable requirement of the Sockeye Salmon Fisheries Convention that the allowable catch be divided as equally as may be practicable between the fishermen of the United States and Canada greatly interferes with what might be termed favorable operating conditions for scientific management. As one country obtains its share of the catch before the other the exact size of the run must be known before it is too late to prevent underfishing or overfishing by regulating the fishing effort of the first country's fishermen. If too many fish are taken by the United States fishermen, the catch of the Canadian fishermen either does not approach equality with the catch of the United States fishermen or the escapement is below that desired. If too few fish are taken by the first country the catch of the second country is too great or the escapement is excessive.

The management complication necessitated by the Convention requirement for the division of the catch can only be offset by improved predictions of the size of incoming runs in advance of the fishery, by improved methods of statistical analyses of the catch which permit a continuing estimate of the population as it passes through the fishery and by the establishment of a fishery which is stable not necessarily as to numbers of units but as to unit efficiency and fishing area. Research and time will provide the means for obtaining good management of the Fraser River sockeye. The catch and escapement resulting from regulatory management at present appears to be relatively satisfactory in practically all

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1942, 1946, 1950, 1954

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1942	1946	1950	1954		Males 4-5 yr.	Females 4-5 yr.
LOWER FRASER								
Cultus Lake	Nov. 18-21	37,305	33,284	30,595	23,756	2,066	10,617	11,063
Upper Pitt River	Sept. 10-15	2,048+	18,520	42,800	17,624	0	8,928	8,696
Widgeon Slough	Nov. 8-10	529	1,404	600	1,000	0	304	696
HARRISON								
Big Silver Creek	Sept. 13-24	7+	——	25	279	——	——	——
Harrison River	Nov. 7-10	112	15,631	33,860	28,800	0	11,314	17,486
Weaver Creek	Oct. 20-21	19,000	36,000	30,700	28,773	345	13,092	15,336
Misc. Streams		942	1,200	350		——	——	——
LILLOOET								
Birkenhead River	Sept. 25-27	87,000	90,000	72,767	41,201	22,240	7,902	11,059
SETON-ANDERSON								
Gates Creek	Aug. 28-Sept. 4				47	——	——	——
Portage Creek	Oct. 18-21			few	3,505	10	1,615	1,880
SOUTH THOMPSON								
Seymour River	Sept. 1-4	1,950	2,600	12,000	26,258	108	2,372	2,696
Lower Adams River	Oct. 10-20	2,168,000	1,841,000	850,500	1,532,820	3,525	681,339	847,956
Little River	Oct. 10-20	400,000	419,000	376,000	427,850	2,481	155,096	270,273
Upper Adams River	Sept. 3-8	——	——	——	205	——	102	103
South Thompson River	Oct. 15-20	Present	92,000	41,500	87,611	259	32,463	54,889
Lower Shuswap					17,462	——	——	——
NORTH THOMPSON								
Raft River	Aug. 24-Sept. 2	450	3,000	6,400	10,551	7	4,854	5,690
CHILCOTIN								
Chilko River	Sept. 23-25	34,100	58,950	29,800	36,534	1,820	13,818	208,961
Taseko Lake	Sept. 8-10	——	——	500	3,500	——	——	——
QUESNEL								
Horsefly River	Sept. 2-5	0	58	400	279	——	——	——
Mitchell River	Sept. 10-15	0	2	0	18	——	——	——
NECHAKO								
Endako River		309	368	900	P			
Nadina River	Aug. 26-Sept. 14	62	66	1,950	2,219	0	841	1,378
Nithi River	Aug. 29-30	1	4	125	46		30	15
Ormonde Creek	Aug. 24-26	54	193	732	538	0	177	361
Stellako River	Sept. 25-27	48,064	245,200	145,100	142,632	23	63,547	79,062
STUART RIVER								
Early Runs								
Ankwil Creek	Aug. 10-13	——	——	67	56	0	27	29
Bivouac Creek	Aug. 3-7	——	——	2,320	387	0	169	218
Driftwood River	Aug. 15-19	——	5	144	387	0	193	194
Dust Creek	Aug. 8-11	——	——	1,125	1,168	0	567	601
Felix Creek	Aug. 3-7	——	——	——	218	0	95	123
15 Mile Creek	Aug. 10-13	——	——	54	41	0	20	21
5 Mile Creek	Aug. 10-13	——	——	262	5	0	3	2
Forfar Creek	Aug. 3-7	3,244	1,822	10,259	5,702	4	2,491	3,207
Forsythe Creek	Aug. 10-13	——	——	2	27	0	13	14
Frypan Creek	Aug. 10-13	——	——	69	266	0	129	137
Gluske Creek	Aug. 3-7	1,734	2,905	11,007	5,292	0	2,417	2,875
Kynoch Creek	Aug. 3-7	1,949	1,843	24,644	14,088	4	6,428	7,656
Leo Creek		——	——	97	4	0	2	2
Narrows Creek	Aug. 4-8	100	277	2,265	2,756	0	1,338	1,418
Paula Creek	Aug. 3-7	——	——	——	36	0	18	18
Rossette Creek	Aug. 3-7	929	2,641	6,260	3,836	0	1,970	1,866
Sakeniche Creek		——	——	234	0	0	0	0
Shale Creek	Aug. 10-13	50	61	628	279	0	135	134
25 Mile Creek	Aug. 10-13	——	——	521	207	0	100	107
Misc. Streams	Aug. 4-8	——	——	42	531	0	257	274
Late Runs								
Kazchek Creek	Sept. 10-13	1	60	243	83	0	41	42
Kuzkwa River		——	——	——	0	0	0	0
Middle River	Sept. 13-16	Pres.	488	2,600	3,927	0	1,737	2,190
Pinchi Creek		——	——	——	5	0	2	3
Sakeniche River		——	——	——	0	0	0	0
Tachie River	Sept. 13-16	——	14	200	1,529	0	868	661
NORTHEAST								
Upper Bowron River		1,826	6,951	16,266	10,774	259	5,343	5,172
TOTALS		2,809,760+	2,893,027	1,786,819	2,485,480+			

cases, although the unit efficiency of some of the gear has changed radically from year to year in each country and the fishing area has not been stable. It appears essential that the industry give serious thought to its responsibility with regard to the establishment of a stable fishery, since errors in management resulting from an unstable fishery lower the revenue derived from that fishery. Competition between units of the industry is only justified as long as it does not injure the industry as a whole.

The 1954 Adams River run provided one of the most difficult problems ever encountered in scientific salmon fishery management. Insufficient data were available for a positive prediction of the size of the incoming run and extensive changes had taken place since previous cycle runs both in the unit efficiency of the fishing fleet and in the area fished by that fleet. Equal division of the greatest catch ever made on this run was obtained, but, because of the changes in the fishing industry combined with natural changes in the character of the upstream migration of the run, an escapement occurred which exceeded the amount believed to be the optimum by approximately 600,000 sockeye. The excess escapement was nevertheless significantly below that permitted on large runs in earlier cycle-years when no information was available to justify setting a maximum limit; thus an improvement in the management of the fishery has been obtained even though the number of fish on the spawning grounds exceeded the maximum number desired.

The 1954 escapement of all sockeye runs including the Adams run apparently spawned under favorable conditions. Fewer fish died unspawned in almost every area than were recorded for the previous six years of complete record. Spawning temperatures were optimum in most areas although all river flows were high as a result of the abnormally large amount of precipitation during most of the summer and fall.

The return in 1954 of spawning sockeye to areas where eyed eggs from selected donor streams were planted in 1950, 205 to Upper Adams River and 3505 to Portage Creek, is discussed elsewhere in this report. However, it is important to note that these returns are considered a very important step in the scientific rehabilitation of the Fraser River sockeye. There is every reason to believe that the seed stock provided by these eyed-egg plants will be capable of maintaining and building-up self-sustaining runs of sockeye in these areas.

The total 1954 run is estimated at 12,115,000 sockeye, which besides the commercial catch and escapement includes the catch by Indians and an estimated 5000 unrecorded sockeye on the certain spawning grounds where observations were impossible. The net escapement for the season, as shown in Table VI, was 20.5 per cent of the total run.

THE 1955 CYCLE

Advance prediction of the size of sockeye populations destined for individual spawning grounds has a distinct economic advantage to the fishing industry, and it is necessary for the design of stable regulations to accomplish equal division of the catch and acquire adequate escapement. Reliable predictions, however,

depend on many inter-relationships. These relationships cannot be demonstrated without adequate data extending over a period of time sufficiently long to be reliable. Adequate data concerning the spawning populations have been recorded for at least ten years and adequate data concerning environmental conditions during spawning and incubation have been collected for the past six years. It is probable, therefore, that pre-season estimates of the size of incoming populations will gradually become more reliable in the years to come.

Unmeasured factors still exist that either do or could control survival rates. One of these factors is the natural adjustment of productivity of each annual run to form the normal pattern of dominance as rehabilitation occurs. Our understanding of how the natural pattern of annual productivity will form is improving but the underlying cause is yet to be isolated and positively identified. The unknown survival rate in the ocean is a second factor. Fortunately the ocean survival rate appears to be reasonably consistent in recent years, but the possibility exists that an unexpected low ocean survival may occur. Great difficulties are involved in determining the survival rates of animals which are not available for constant or frequent observation. This can only be counter-balanced by intensive investigation during the periods they are available for observation. Considerable effort is being directed toward obtaining the data necessary for accurate prediction but current anticipations must be advanced with considerable reservation.

The spawning escapement which was available to produce the 1955 run was well-distributed and of sufficient size to produce a run as large or larger than that which occurred in the spawning year 1951. The temperature during the period of spawning and incubation was below normal, but in most instances it was not below that *believed* to be necessary for a reasonable fry survival rate. There is no indication that any existing spawning population located above Hell's Gate is forming a dominant population on this cycle. Sub-dominant populations exist in the Adams and Chilko areas on this cycle, hence the runs to these two areas are expected to be the major contributors to the 1955 catch.

The relative failure of the 1954 run of three-year-old jacks—preceding the 1955 run—destined for the spawning areas above Hell's Gate should be noted. In some cases over the past six years the jack run has been a fair indicator of the size of the run of four-year-old adults in the year following. More than 12,000,000 seaward migrants resulting from the 1951 spawning at Chilko were counted, and large but uncounted numbers of migrants resulting from the 1951 spawning were observed leaving Stuart and Shuswap Lakes. This contradicts the failure of the jack run as a possible indicator of the size of the 1955 run. Poor ocean survival of seaward migrants might be indicated by the poor jack run above Hell's Gate in 1954, but this consideration is contradicted by the rather large runs of jacks returning to the spawning areas below Hell's Gate.

The Early Stuart run, which is the only population of sockeye supporting the fishery in late June and early July, is expected to be larger than that occurring in 1954, and it could be larger than the cycle-year run of 1951. No run or combination of runs is expected to be sufficiently large to provide significant

Table VII

DAILY CATCH OF SOCKEYE, 1939-1943-1947-1951 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1939	1943	1947	1951	1939	1943	1947	1951	1939	1943	1947	1951
1		2			8,042	5,690	9	57,324	10,693	1,858	2,952	
2				13,102	5,817	8,916	10	42,143	546	2,084	1,587	933
3				6,615	5,646	14,001	4	27,199	8,982	1,270	1,181	544
4				9,589	2,209	14,738	6		7,493		1,482	990
5				9,057	199	7,784	47		6,353	1,057	984	502
6				9,490	9,709	6,683	147	45,986	11.803	931		334
7		23			6,394	9,361	826	27,966	6,229	914	714	138
8		3			7,980	3,655	46	33,746	5,784	1,302	622	
9	31	1		23,677	10,581	4,282	352	20,411	4,330	1,022	246	262
10		25		10,244	9,643	5,582	1,100	56	3,084	1,168	406	1,254
11	38	16		8,156	4,758	10,510	526		1		316	33,599
12	82	66		6,570	762	10,436	559		1	210	248	6,580
13	19	178		5,418	12,888	5,386	5	56,686	26	357		290
14	7	417			14,150	95	37	40,432	3	346	805	138
15	191	442			15,361	8,398	45	40,912	1	232	107	
16	741	1,319		16,435	13,024	4,918	710	39,620	12	145	105	149
17	384	515		16,565	12,935	4,948	3	23,050	89	45	443	234
18	530	2,025		12,476	9,759	5,913	4,376	310	160		125	109
19	2,186	1,969		13,506	824	4,554	8,743	396	127	18	240	109
20	2,656	4,328		14,630	18,494	1,265	8,431	10,041	93	13		285
21	4,305	2,334	6		32,831	66	7,839	10,788	92	27	69	216
22	65	1,907	21		30,121	6,037	3,944	8,337	70	45	87	
23	3,633	1,723	9	58,796	39,537	7,699	79	5,758	1	20	272	38
24	6,950	2,428		59,917	44,963	6,250	8,119	2,214	55	8	57	9
25	7,187	5,548		54,748	17,349	7,424	4,953	83	2,476		36	14
26	6,814	5,248	8	45.817	537	5,017	5,894	4	1,206	3	42	7
27	7,532	3,241	14	42,981	25,856	2,276	6,234	2,471	40	8		1
28	5,890	4,050			21,300	6	5,536	7,489	36		13	2
29	2	5,903			17,624	3,849	3,097	2,334	43	3	6	
30	2,858	4,523		64,435	16,380	2,911	7	1,346		2	10	
31	6,857	157		79,869	10,239	1,497	3,314	859				
Totals	58,958	48,391	58	582,093	425,912	180,147	74,998	507,961	69,829	13,088	13,155	46,737
June Total		150										
Oct. Total									555		8	
Season Total									555,254	241,776	88,219	1,136,791

Table VIII

DAILY CATCH OF SOCKEYE 1939-1943-1947-1951 FROM CANADIAN TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1939	1943	1947	1951	1939	1943	1947	1951	1939	1943	1947	1951
1		85			6,461			34,757	14,739	5,671	508	
2		81		24,501	5,078	10,977		50,315		8,391	229	52
3	60			16,133	5,340	10,070		14,127		140	216	32,198
4	53			13,850	5,969	8,086			27,177		646	15,955
5	57	98		14.078		7,688			30,495		138	12,617
6	174	123		1,500		1,557		63,292	36,472	15,811	113	10,675
7	289	148			6,297			30,490	16,928	5,099	8	6
8		155			4,476			33,448	9,023	2,176	15,158	
9		247		20,406	5,104	8,469		29,668		2,250	9,684	20
10	164			11,909	4,911	5,114		18,040		53	6,796	15,622
11	190			8,186	6,759	6,238			9,406		5,537	7,739
12	498	395		9,464		7,759			8,372		52	9,229
13	1,016	365		3,000		901		59,457	6,996	3,567	37	12,047
14	1,218	510			18,366			27,445	4,746	1,895	5	25
15		1,311			9,193			13,579	9,521	2,158	25,814	
16		1,444		15,184	6.274	10,597		8,442		3,916	29,309	4
17	2,880			10,116	4,063	10,765		2,453			44,304	40,944
18	2,652			10,134	6,251	9,288	1,827				39,708	27,599
19	2,662	4,480		13,384		9,166	2,115	1,541		31,655		19,424
20	3,096	4,617		1,580		417	1,342	22,812		13,962		313
21	5,615	3,916			16,290		1,030	10,325		7,839		54
22		4,733			15,580		333	14,583		6,601	31,284	
23		4,905		38,081	15,163	7,659	34	16.428			33,250	0
24	6,153			30,178	12,532	3,966	15	392			54,538	24,783
25	4,453			32,319	21,582	5,397	1,339		10,070		22,593	12,057
26	4,046	5,707		43,327		6,534	904	305	5,939		21	5,139
27	4,720	6,108		10,313		203	530	46,086	4,679	21,961	3	
28	4,981	4,549			29,251		1,093	23,673	7,600	8,167		
29		5,652			15.457		548	17,925		4,242	5,404	
30		455		76,209	14,607	8,978	440	20,425		3,648	1,572	
31	11,844			39,931	12,475	5,058	101	228				
Totals	56,821	50,084		443,783	247,479	144,887	11,651	560,236	202,163	149,202	326,927	246,502
8" Gillnets			3,469				5,165					
May & June Totals	577	669	1,096	31,021								
Oct. & Nov. Totals									61,903	4,169	6,727	6,620
Season Total									568,943	349,011	355,035	1,288,162

CLOSED

catches until the Chilko, Pitt, Raft, and Seymour runs overlap each other in their passage through the fishery during the last ten days of July and the first few days of August. The seaward migration of fingerlings from the 1951 spawning at Chilko is believed to be sufficiently large to provide a decided increase in the 1955 run over that of the cycle-year, provided that the ocean survival rate was normal. Of the runs occurring in late July, the Pitt River run is expected to be next in size to that destined to Chilko.

The August runs to Birkenhead River and Adams River are expected to be good. The Stellako run could show a decline. Unusually cold water existed during the spawning and incubation period of the 1951 Stellako escapement, and dominance is obviously forming on the 1954 cycle.

REHABILITATION OF BARREN AREAS

Experiments related to the rehabilitation of depleted spawning areas and eventually to the possible extension of the Fraser River sockeye fisheries have been carefully controlled since their inauguration in 1949. This control has been necessary in order to record all the biological data available in connection with the experiments; without such data the reason for success or failure of each experiment could never be assessed and little would be added to our knowledge of the forces controlling the successful reproduction of the species. The magnitude of each experiment has therefore been limited so that important biological information could be collected.

The adult return of artificially reared sockeye fingerlings to the hatchery discharge pipe in 1952 and 1953, without significant straying to the native spawning area of their parents, was described in the 1953 Annual Report. Since the fingerlings had not been allowed to proceed downstream to Quesnel Lake but were flown there direct from the hatchery the possible importance of the olfactory organ in the "homing" of sockeye salmon was indicated. Equally interesting is the complete failure of any of 84,000 sockeye fingerlings of the 1949 brood year to survive and return as adults to the Adams River watershed in 1953. This experiment consisted of transferring "green" eggs in the fall of 1949 from the Seymour River to the Quesnel Field Station where they were incubated and hatched and the resultant fry reared until November 1950. The fingerlings from this lot were in excellent condition when transplanted by air to the point where the upper Adams River flows into Adams Lake. A substantial share of the fish were marked when planted and were therefore identifiable throughout their life but none returned to the Adams River watershed in 1953. Careful observation in the area and even in the commercial fishery supports the belief that there were no adults surviving from this planting.

A similar release in Anderson Lake of 193,000 fingerlings that were hatched from eggs of the Late Adams run in 1950 also failed to produce any returning adults. A plant of 15,000 fingerlings in Lac la Hache in the same year likewise failed to return any adults to the lake drainage stream commonly referred to as the San Jose River. Adult returns from other plants of fingerlings in the Little Horsefly River drainage, Mabel Lake drainage, and Upper Adams River

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1939, 1943, 1947, 1951

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye			
		1939	1943	1947	1951
LOWER FRASER					
Cultus Lake	Nov. 21-26	73,189	11,875	8,898	13,143
Upper Pitt River	Sept. 15-18	——		1946 18,520	37,837
Widgeon Slough	Nov. 9-12	——	293	750	745
HARRISON					
Big Silver Creek	——	29	Present		200
Douglas Creek	——	156	Present		20
East Creek	——	25	9		15
Harrison River	Nov. 20-23		1,114+	16,000	17,145
Hatchery Creek	——	107	77	500	100
Weaver Creek	Oct. 21-24	3,253	3,128	6,500	12,979
LILLOOET					
Birkenhead	Oct. 1-5	15,280	50,668	120,000	55,862
U. Lillooet Streams	——	1,130	Present	Present	50
SOUTH THOMPSON					
Seymour	Aug. 22-25	250	Present	10,000	24,344
Adams L. & Trib.	——	——	——	0	0
Adams River	Oct. 14-16	16,200	10,000	185,000	135,000
Little River	Oct. 16-17	15,687	Present	15,000	9,690
South Thompson River	Oct. 16-17	——	——	100	500
NORTH THOMPSON					
Raft River	Aug. 28-31	1,490	4,000	8,000	8,561
Barriere River	Aug. 30	——	——	——	108
SETON-ANDERSON					
Portage Creek	——	——	——	50	30
CHILCOTIN					
Chilko River	Sept. 20-23	2,000	13,546	55,000	118,110
Taseko River	Sept. 5-9	——	——	——	500
QUESNEL					
Horsefly River	Aug. 26	——	——	6	51
NECHAKO					
Endako River	Aug. 30-Sept. 2	8	46	450	742
Nadina River	Aug. 26	——	——	90	326
Nithi River	Aug. 24	3	——	60	90
Ormonde Creek	Sept. 2-4	——	——	40	120
Stellako River	Sept. 28-Oct. 1	1,446	9,142	55,000	96,200
Uncha	——	——	——	2	30
STUART					
Ankwil Creek	Aug. 15	——	——	——	25
Driftwood River	——	——	——	0	50
25 Mile Creek	——	——	——	——	5
15 Mile Creek	——	——	——	0	7
Forfar Creek	Aug. 4-8	89	400	1,500	13,600
Frypan Creek	Aug. 15	——	——	——	50
Gluske Creek	Aug. 6-10	——	——	200	3,787
Kazchek Creek	Sept. 6-10	2	2	——	200
Kynoch Creek	Aug. 4-8	458	2,150	10,000	32,825
Middle River	Sept. 12-16	——	——	60	2,000
Nahounli Creek	Aug. 15	——	——	0	40
Narrows Creek	Aug. 12-16	6	5	——	400
Rossette Creek	Aug. 4-8	——	450	2,500	10,000
Shale Creek	Aug. 15	——	——	0	190
Sowchea Creek	Aug. 11	——	——	——	30
Tachie River	Sept. 12-16	——	——	——	100
NORTHEAST					
Bowron	——	2,695	6,215	23,945	21,770
TOTALS		133,503	113,120+	538,171	617,577

—— No observation.

are due in 1955 and 1956 but it is already indicated that fingerling transplantations from one watershed to another have little possibility of success, especially when the incubation of the eggs and the rearing of the fry is conducted on an entirely different watershed from either the donating or the receiving drainage area. It is possible that the fingerlings used in the unsuccessful experiments did not withstand the shock of aerial transportation but there was no indication of this at the time of planting; the fish swam normally immediately after all plantings and tended to school under the pontoons of the plane.

In contrast to previous fingerling transplanting experiments two "eyed-egg" transplanting experiments completed this year were eminently successful. In 1950 a total of 667,000 Seymour River sockeye eggs were eyed at a temporary station on the Seymour River and were then transferred to the Upper Adams River, where approximately 50 miles of the river channel are available to adult sockeye. Seymour and Upper Adams Rivers are both in the South Thompson watershed, are equi-distant from the sea, drain the same mountain range, and have similar annual water temperature cycles. In spite of a heavy fishery in 1954, 205 adults returned to the Upper Adams River as a result of the transplantation in 1950. *All the fish spawned successfully at the right temperature and in the area where the eggs were planted in spite of the fact that many miles of potential spawning grounds were available to them.* The nuclear ring count of the scales indicated that the fry had grown up in Adams Lake instead of Shuswap Lake which was also available to them and is the normal lake rearing area for Seymour River sockeye. While the returning adults could not be positively identified, because the original fingerlings could not be marked, the complete lack of spawners in this river for many years past combined with the spawning of the returning fish in the exact riffle where the eggs were planted provides almost indisputable evidence of the success of the experiment.

A similarly successful eyed-egg transplanting experiment brought about the return of 3505 adult sockeye to Portage Creek in the Seton-Anderson Lake system. Eggs taken from the Lower Adams River sockeye run in 1950 were eyed in the donor stream and during January 1951 approximately 300,000 were transplanted to selected gravel areas in Portage Creek where it flows out of Anderson Lake. The distance from the sea of Lower Adams River and Portage Creek is approximately the same, both streams have their sources in lakes, and their temperature cycles are alike. The success of this experiment is not measured as easily as that of the Upper Adams River experiment since a few pair of native sockeye were noted spawning in Portage Creek in 1950, the brood year. Nevertheless large numbers of adults returning to Portage Creek in 1954 in spite of a commercial fishery that took approximately 75 per cent of the run, the high percentage of these fish that spawned where the eggs were planted, and the small number of native fish in the creek in 1950 creates confidence in the success of the Portage Creek experiment. All the fish spawned successfully, at the right time and in favourable water temperatures. A plant of 193,000 fingerlings of the same brood year had also been made but examination of 230 scale samples showed that none of the returning adults were from this plant.

None of the samples showed the nuclear-area pattern that is characteristic of an artificial rearing period.

New transplantation experiments were conducted in both the Middle Shuswap River and the Little Horsefly River in 1954 using eggs that were artificially spawned from the 1954 late Adams River run and placed in a floating incubation station at the outlet of Adams Lake. When the eggs had reached the eyed stage, 1,396,000 were planted in the Middle Shuswap River above Mabel Lake. A normal run of sockeye spawns below Mabel Lake in the Shuswap River and the resultant fry drop downstream into Mara Lake and probably into Shuswap Lake but the spawning grounds of the Shuswap River *lying above Mabel Lake,* commonly referred to as the Middle Shuswap River grounds, have been barren for a number of years. The transplantation was made in an effort to bring both the spawning ground available in the Middle Shuswap River and the large potential rearing area represented by Mabel Lake into production. The planted eggs were from a stock spawning in a stream whose temperature cycle was not precisely the same as that of the planted area, but no other existing stock of sockeye spawned in an environment more closely related to that of the Middle Shuswap River. On November 23, 1954, a further 390,000 eyed eggs from the lot that supplied the Shuswap River planting were flown to the Quesnel Field Station. The eggs arrived at the station in excellent condition and were planted in the Little Horsefly River near the highway bridge during the succeeding three days. During this time the water temperature of the planting area was 43.5°F. which was very close to the 43.0°F. of the donor stream.

Another eyed-egg transplanting experiment during 1954 involved the transfer of 258,000 eggs from the eyeing station on the Seymour River to Salmon River, both streams being tributary to Shuswap Lake. The once-large sockeye run to the Salmon River is extinct and the Seymour stock meets all the requirements of a potentially successful experiment.

The velocity of flow, depth of water, and size of gravel on the grounds used for spawning by existing populations of sockeye have already been measured in most of the larger spawning areas and this information was fully utilized in the selection of the areas in which to plant eyed eggs. All the areas where eggs were planted in 1954 were selected on the basis of physical surveys as being suitable spawning areas for returning adults.

The experimental artificial spawning ground constructed at the Quesnel Field Station in 1953 and referred to in the 1953 Annual Report proved eminently successful in spite of its rather crude design. A detailed summary of the results is as follows:

	Areas 1 and 2	Area 3
Average number of eggs per fish	3,723	3,723
Number of females	67	34
Calculated number of eggs available	249,441	126,582
Calculated number of eggs deposited	180,617	102,294
Percentage egg deposition	72.41%	80.81%
Fry yield	86,496	44,143
Percentage of eggs deposited that became fry	47.89%	43.15%
Percentage of eggs available that became fry	34.64%	34.87%

FIGURE 3. Planting eyed-eggs from Seymour River in potential but now barren spawning areas of the Upper Adams River, October 26, 1954.

These preliminary results show that the possible importance of artificial spawning grounds in extending the sockeye fisheries of the Fraser River merit consideration. This is emphasized by the natural mortality figures obtained at Chilko Lake, one of the largest natural sockeye producing areas of the Fraser River system, which reveal a 6.5 to 7.5 per cent egg-to-fry survival and a 35.0 to 42.0 per cent fry-to-yearling survival. Further effort will be expended to determine the physical requirements of a biologically perfect artificial spawning area. If suitable water supplies can be found, large lakes such as Horsefly Lake and others, might possibly be brought into production. However, there are several obstacles to the practical success of artificial spawning grounds: it is necessary to secure a water supply with a temperature cycle that will permit the fry to emerge when the zooplankton, on which they must subsist, have their spring blooming. A race of donor sockeye must also be found which will return to the artificial spawning area at the proper time for successful reproduction. It may be possible to solve these problems and continuous research will be conducted in an attempt to comply with that term of reference of the Convention which provides for the *extension of the Fraser River sockeye fisheries.*

The adult return from the eyed-egg experiments already provides every hope for restocking those areas whose populations were exterminated by the Hell's Gate blockade.

WATERSHED PROTECTION

Each year new problems arise requiring action by fisheries agencies to minimize or eliminate the adverse effects of industrial developments on the salmon of the Fraser River watershed. The Commission, with its single responsibility for Fraser River sockeye, collaborates closely in these problems with the Department of Fisheries of Canada, which has legal responsibility for protection of all commercially-caught species in British Columbia.

The problem of protection of salmon in the Nechako River, which arose as a result of the Aluminum Company of Canada's diversion of the stream for power purposes, has occupied the attention of the Commission as well as the Department of Fisheries for several years. In 1954, as in 1953, a prolonged period of cool weather with abundant rain made it unnecessary to release stored water from the Cheslatta reservoir to aid sockeye in their migration up the Stuart-Nautley portion of the Nechako River. The Cheslatta reservoir was constructed on a tributary of the Nechako River below Kenney Dam by the Aluminum Company of Canada. Water stored throughout the year in this reservoir may be released as required to aid sockeye migration and to provide flow for migration and incubation purposes for spring salmon. Full information regarding this fisheries problem is contained in preceding annual reports of the Commission and in several special joint reports by the Department of Fisheries and the Commission.

The wet summer of 1954 kept the flow of the Nechako at Vanderhoof far in excess of the desired minimum of 1000 cubic feet per second. In fact during the passage of the Stellako sockeye it did not fall below 3000 cfs, but this included water that had to be released because it was threatening to overtop the Cheslatta

reservoir and endanger the storage dam. As a result sockeye passed up the river unhampered by either low flow or high temperatures.

Excessive rainfall has accelerated filling of the main reservoir behind Kenney Dam with the result that water from the gates at the Skins Lake spillway will probably be available if required to augment Cheslatta releases for fishery purposes in 1955. By 1956 the main reservoir is expected to be full and, until consumption of water for power production at Kemano increases markedly, the spill should be sufficient to maintain the Nechako River flow at almost its natural volume.

At Seton Creek, near Lillooet, contractors for the British Columbia Electric Company continued throughout the year with the construction of a 25-foot intake dam, canal and powerhouse. Sockeye spawning areas in Portage and Gates Creeks, above the dam, will be accessible through a vertical slot fishway surmounting the dam. Power will not be developed until 1956, but the fishway will operate for the first time during the 1955 season when the entire flow of the stream will be diverted through the spillway at the dam in order to allow construction of the power canal intake. Excellent co-operation has existed between the builders of the project and the fisheries agencies.

An oil refinery situated near Kamloops began operations in early 1954. Prior to construction of this plant waste disposal had been the subject of special consideration by the Department of Fisheries and the Commission in consultation with the plant owners. Facilities for handling waste effluents by separation and lagooning have so far proved adequate and no effluent has entered the Thompson River. Evaporation and percolation from the lagoon have kept pace with the inflow of liquid wastes.

The hydroelectric plant on the Barriere River, tributary to the North Thompson River, was taken out of service several years ago by the British Columbia Power Commission as Kamloops and vicinity could be served with electricity from the Whatshan plant. The diversion dam on the main stream and the storage dams on North and East Barriere Lakes, all of timber construction, were breached in 1952 to allow the passage of residual runs of sockeye and other anadromous fish. Further work will be required on the North and East Barriere dams to prevent formation of jams or other impediments to the upstream passage of fish. The Power Commission, at the instigation of the Department of Fisheries, has agreed to undertake this work early in 1955.

Topographic surveys were made of the falls on the Horsefly and Nadina Rivers. Engineering studies of the feasibility of fishway construction can now proceed simultaneously with biological assessment of the desirability of providing spawning sockeye with access to the areas above the falls. On the Horsefly River an additional investigation was concerned with the effect of placer gold-mining operations on the spawning and incubation of sockeye eggs as silt produced by mining operations has been shown to have deleterious effects upon other species of aquatic life. Field work has centered upon assessment of the production, transportation and deposition of silt. Laboratory investigations are being conducted

to determine the effect on eggs incubating in gravel of varying quantities and of different particle sizes and times of deposition of the silt.

Hydraulic barkers, which use jets of water under pressures of up to 2000 lbs. per square inch to remove bark from logs, are becoming increasingly common at sawmills along the lower Fraser River. A survey revealed that the debris produced by these machines was being screened to remove all but the very fine particles, which are discharged into the Fraser River in most, if not all, cases. Since the fine particles that are released accumulate as a heavy, almost inert, material in the river bed, the possibility of improving the present methods of screening or disposal has been studied during 1954 by the Department of Fisheries and the Commission.

At the end of the year it was announced that a license has been granted for a brewery which will produce 65,000 barrels of beer annually at a site near the Nechako River at Prince George. The problems of waste disposal at this plant, insofar as protection of fish is concerned, are being studied by the Commission.

A study of the fishery and hydroelectric power potentials of the Clearwater River system was almost completed during the year. Some further information regarding the annual water-temperature cycle in the stream will be required before the possibility of introduction of sockeye into the system can be finally decided but it was established that development of power from this source for use in the central interior portion of British Columbia would not seriously interfere with any *potential* sockeye fishery if such a potential exists.

Late in the year it was announced that the Federal Government of Canada would undertake a study of the feasibility of diverting flow from the Columbia River near Revelstoke into the Fraser River system. The purpose of such a diversion would be to augment low flows of the Thompson River system and of the Fraser River below Lytton, and so facilitate steady output at a high rate from hydroelectric sites which would be developed on the Thompson and Fraser Rivers. A negligible amount of data is available at present regarding the possibility or practicability of such a gigantic proposal. Fisheries implications of the proposal have been tentatively considered by the Commission and studies will continue as data regarding the suggested development become available.

At Sweltzer Creek, which drains Cultus Lake, the Commission continued investigations of methods for guiding downstream migrant sockeye. The experiments, begun in 1953, were undertaken to determine the effectiveness, limitations, practicality, and immediate or delayed physiological effects of techniques for protecting young sockeye from the hazards of turbines and spillways at power dams. Electrical guiding methods, applied on the largest scale possible in the shallow waters of the creek, were successful in diverting a high proportion of yearling sockeye to a selected by-pass. One hundred thousand of these migrants were marked and used in a controlled test of the possible delayed effects of the electrical field. Results will not be known until the marked fish return as adults in 1956. Further investigations of the complex problems involved in protecting sockeye migrants at dams will be made.

The fishways at Hell's Gate and Bridge River Rapids on the Fraser River and at Farwell Canyon on the Chilcotin River were maintained in proper operating condition throughout the season. At Hell's Gate the unusually high water-levels required the Adams River sockeye run to use the fishways for its entire period of passage from September 24th to October 4th. Normally this race, because of its late-season timing, passes Hell's Gate when the gauge-levels are below 25 feet and the natural channel is consequently passable. The 1954 Adams spawning escapement would have been substantially destroyed at Hell's Gate had the fishways not existed, and a quadrennial run worth approximately $28,000,000 would have been lost to the *future resource economy* of Canada and the United States. The unprecedented size of the Adams River escapement arriving below Hell's Gate on the peak day, estimated at over 1,000,000 fish, slightly exceeded the capacity of the fishways and a minor delay in upstream migration occurred. A similar effect was noted elsewhere along the Fraser and Thompson canyons where the marginal areas suitable for sockeye passage are of limited capacity.

Improvements were made to the public parking area and access trail at Hell's Gate. Over 9,000 persons visited the fishways during the year, in spite of the vertical climb of over six hundred feet from river level to the highway. Plans are being made to extend the Commission's private road leading down towards the fishways from the highway to provide emergency access for maintenance equipment.

Industrial developments which may affect the fisheries resources of the Fraser River system present the Commission with a continuous problem of anticipation and analysis. It is not practicable for every suggested industrial venture to be analyzed in detail as to its possible effect on fisheries—many schemes are dismissed as conjectural or infeasible. With its limited staff the Commission must choose for investigation those developments which are recognized as having deleterious effects on fish and which are most likely to be actually undertaken in the near future.

1954 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1953.

2. Research Bulletin Number V
   The Selective Action of Gillnets on Fraser River Sockeye Salmon, by Alvin E. Peterson.

3. Research Bulletin Number VI
   An Investigation of the Effect of Baker Dam on Downstream-Migrant Salmon, by J. A. R. Hamilton and F. J. Andrew.

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